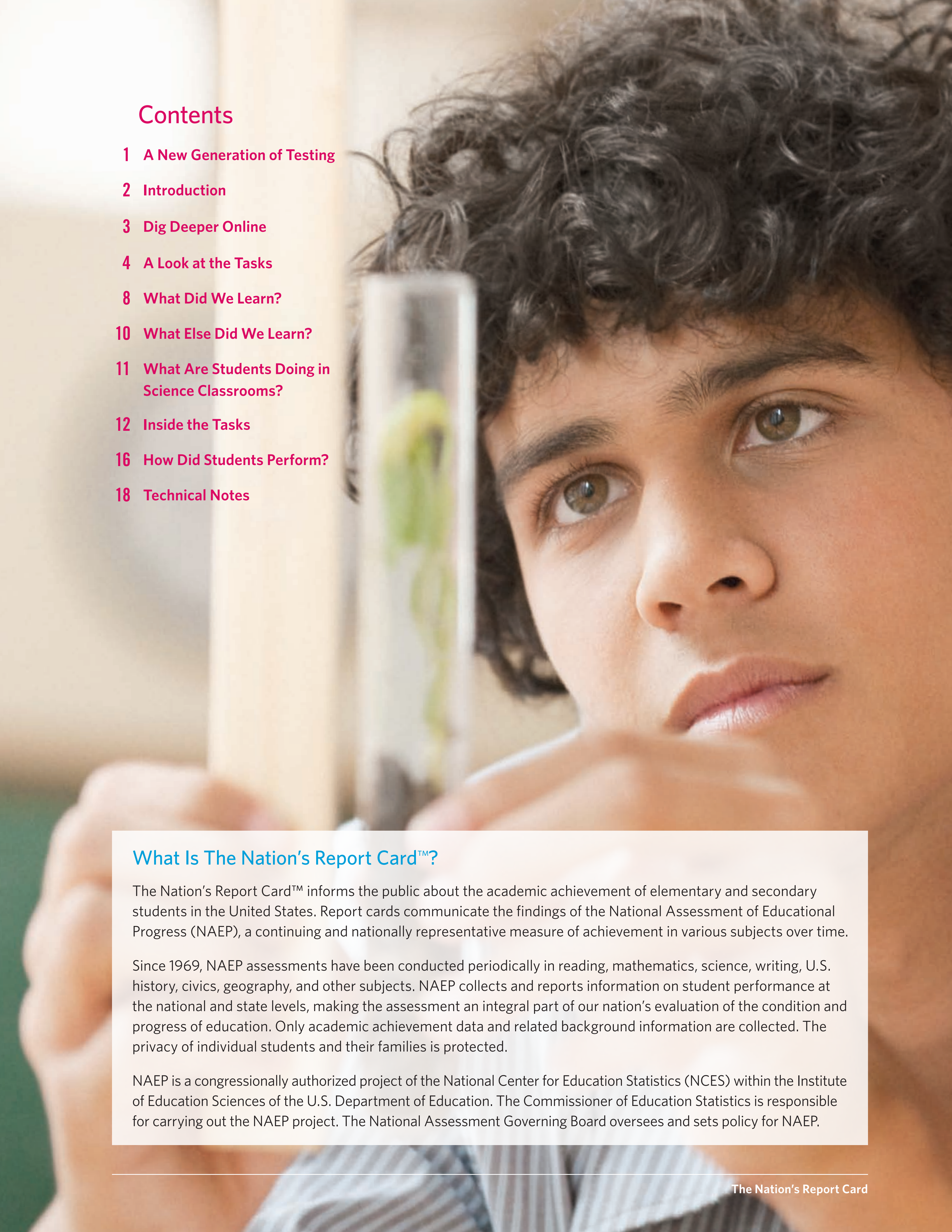
The Nation's Report Card

Science in Action

Hands-On and Interactive Computer Tasks From the 2009 Science Assessment

National Assessment of Educational Progress at Grades 4, 8, and 12

ies NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences
U.S. Department of Education
NCES 2012-468



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What Is The Nation's Report Card™?

The Nation's Report Card™ informs the public about the academic achievement of elementary and secondary students in the United States. Report cards communicate the findings of the National Assessment of Educational Progress (NAEP), a continuing and nationally representative measure of achievement in various subjects over time.

Since 1969, NAEP assessments have been conducted periodically in reading, mathematics, science, writing, U.S. history, civics, geography, and other subjects. NAEP collects and reports information on student performance at the national and state levels, making the assessment an integral part of our nation's evaluation of the condition and progress of education. Only academic achievement data and related background information are collected. The privacy of individual students and their families is protected.

NAEP is a congressionally authorized project of the National Center for Education Statistics (NCES) within the Institute of Education Sciences of the U.S. Department of Education. The Commissioner of Education Statistics is responsible for carrying out the NAEP project. The National Assessment Governing Board oversees and sets policy for NAEP.

A New Generation of Testing

Science education is not just about learning facts in a classroom—it's about doing activities where students put their understanding of science principles into action. That's why two unique types of activity-based tasks were administered as part of the 2009 National Assessment of Educational Progress (NAEP) science assessment. In addition to the paper-and-pencil questions, fourth-, eighth-, and twelfth-graders also completed hands-on and interactive computer tasks. These tasks help us understand not only what students know, but how well they are able to reason through complex problems and apply science to real-life situations. While performing the interactive computer and hands-on tasks, students manipulate objects and perform actual experiments, offering us richer data on how students respond to scientific challenges.

Here's what we learned about student performance across the tasks:

Students were **successful** on parts of investigations that involved limited sets of data and making **straightforward observations** of that data.

1

Students were **challenged** by parts of investigations that contained **more variables** to manipulate or involved strategic decision making to collect appropriate data.

2

The percentage of students who could **select correct conclusions** from an investigation was **higher** than for those students who could select correct conclusions and **also explain** their results.

3

These three key discoveries will be discussed in more depth on pages 8 and 9.

EXPLORE THE TASKS

This report is the print companion to the NAEP interactive website at **http://nationsreportcard.gov/science_2009/**.

Introduction

Interactive computer and hands-on tasks were designed to assess how well students can perform scientific investigations, draw valid conclusions, and explain their results. As a part of the 2009 science assessment, a new generation of hands-on tasks was administered during which students worked with lab materials and other equipment to perform experiments. While hands-on tasks have been used in NAEP since the 1990s, these new tasks present students with more open-ended scenarios that require a deeper level of planning, analysis, and synthesis. For the first time, the NAEP science assessment also included interactive computer tasks in science.

The New Science Framework

The National Assessment Governing Board oversees the development of NAEP frameworks that describe the specific knowledge and skills that should be assessed in each subject. Frameworks incorporate ideas and input from subject area experts, school administrators, policymakers, teachers, parents, and others. The 2009 science framework was developed to keep the assessment content current with key developments in science standards, innovative assessment approaches, and recent research in both science and cognition.

The 2009 science framework recommends that new types of performance-based tasks be assessed, including hands-on tasks and interactive computer tasks. These activity-based tasks allow us to examine students' abilities to combine their science knowledge with real-world investigative skills.

Hands-on tasks are 40-minute activities where students use materials and laboratory equipment to perform actual science experiments. These tasks provide students an opportunity to demonstrate how well they are able to plan and conduct scientific investigations, reason through complex problems, and apply their scientific knowledge in real-world contexts. At each of the three grades, more than 2,000 students were administered the hands-on tasks.

Interactive computer tasks are either 20 or 40 minutes in length and require students to solve scientific problems in a computer-based environment, often by simulating a natural or laboratory setting. These tasks provide students an opportunity to demonstrate a broad range of skills involved in doing science, but without many of the logistical constraints associated with the hands-on tasks. More than 2,000 students were administered the tasks at each of the three grades. The hands-on and interactive computer task assessments were given to separate national representative samples.

The complete science framework for the 2009 assessment is available at **http://www.nagb.org/publications/frameworks/science-09.pdf**.

Predict, Observe, Explain

As suggested in the science framework, some of the hands-on tasks and interactive computer tasks use a Predict-Observe-Explain problem set to engage students in the scientific process.

Predict
Students provide a prediction for what might happen in a real-world science situation

Observe
Students conduct an investigation and observe what happens

Explain
Students explain what they have observed by interpreting data or drawing conclusions

Dig Deeper Online

A Look at the Tasks

Hands-On Tasks

The descriptions below provide an overview of the two hands-on tasks that were administered at each grade. To explore some of these tasks on the interactive website, visit the corresponding links.

Grade 4

How Seeds Travel

In this five-part task, students investigate the structural characteristics of nine types of seeds to determine whether they are spread by wind or by animals. Students finish the task by predicting which seeds might travel the farthest and designing a possible investigation to test which seeds travel farther by wind.

Electrical Circuits

In this four-part task, students learn to assemble a simple electrical circuit. Then students investigate the conductivity of objects and the effect of multiple components in a series circuit. Finally, students use their knowledge learned from comparing different circuits to design and conduct an investigation to determine which of two black boxes contains a light bulb.

http://nationsreportcard.gov/science_2009/hot_g4_scoring.asp

Grade 8

Magnetic Fields

In this three-part task, students design and conduct investigations based on observations of magnetic properties to determine what materials make up four metal bars. First, they use only the metal bars themselves. Students then repeat the investigation using a test magnet and compare the results of the investigations to confirm their conclusions. Finally, students design and conduct two different tests to compare the magnetic strength of a strong and a weak magnet.

http://nationsreportcard.gov/science_2009/hot_g8_scoring.asp

What's Cooking?

In this two-part task, students investigate physical and chemical properties of four common cooking ingredients. Then students use the results of their first investigation to identify the ingredients in a mixture.

Grade 12

Plant Pigments

In this two-part task, students investigate extracts from three unidentified organisms that were collected from the coastline of an island in the Pacific Ocean. Students determine what type of pigments each organism contains, and then they use their results together with other information to predict the type of organism that is most closely related to the unknown organisms.

Maintaining Water Systems

In this three-part task, students make a preliminary recommendation for which of two sites would be the better location for building a new town based on which site might have better water quality. Students then test water samples from both sites and determine whether the samples meet federal standards for various pollutants. Finally, students provide a final recommendation for the better site to build the town based on their results.

http://nationsreportcard.gov/science_2009/hot_g12_scoring.asp

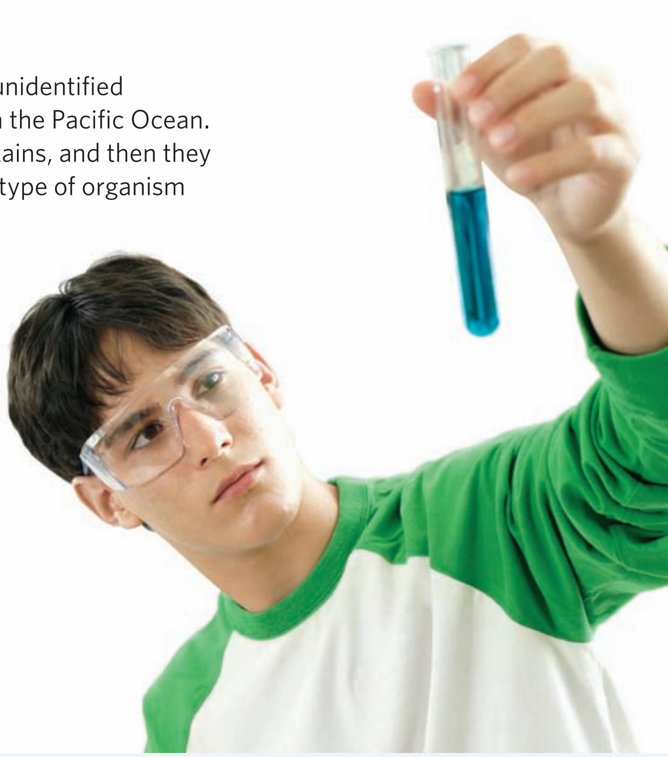

Table 1.
Average percent correct score for all hands-on tasks in NAEP science, by selected student characteristics and grade: 2009

		Gender		Race/ethnicity				Eligibility for NSLP[1]	
	All students	Male	Female	White	Black	Hispanic	Asian/ Pacific Islander	Eligible	Not eligible
Grade 4	47	45	49	51	37	42	53	41	52
Grade 8	44	43	45	48	35	37	45	38	48
Grade 12	40	39	41	45	29	35	43	—	—

— Not available.

[1] National School Lunch Program.

NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

EXPLORE THE TASKS

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Interactive Computer Tasks

The descriptions below provide an overview of the three interactive computer tasks that were administered at each grade. To explore each of these tasks on the interactive website, visit **http://nationsreportcard.gov/science_2009/ict_tasks.asp**.

Grade 4

Mystery Plants

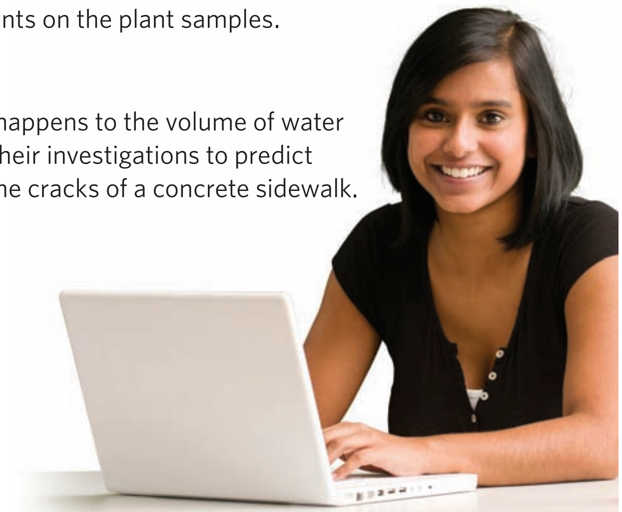
In this 40-minute extended task, students use a simulated greenhouse to determine the best sunlight or fertilizer amounts for two different plants. Students begin the task by showing their prior knowledge about how sunlight and nutrients are related to optimal plant growth. Then students run three separate investigations and draw their conclusions about the effect of sunlight and nutrients on the plant samples.

Cracking Concrete

In this 20-minute task, students investigate what happens to the volume of water when it freezes. Then students use the results of their investigations to predict and test what will happen when water freezes in the cracks of a concrete sidewalk.

Here Comes the Sun

In this 20-minute task, students use a time lapse simulation to make observations about the path of the sun as it relates to the amount of daylight. Students use this knowledge to determine the better of two locations for growing tomatoes.



Grade 8

Bottling Honey

In this 20-minute task, students investigate how four different liquids behave when they are poured and how temperature affects the flow rates of the liquids. Then students determine the best temperature range for bottling honey that will take the least amount of time while using as little energy as possible.

Playground Soil

In this 20-minute task, students investigate the permeability of soil samples from two sites a town is considering for a play area. Students use their results to help decide which site has the better water drainage and is therefore the better place for a grassy play area.

Planning a Park

In this 40-minute extended task, students help plan a new recreation area for a town using a small portion of an existing wildlife area. Students evaluate the potential impact that various locations of the recreation area would have on the population of the meadow vole and other animals. By the end of the task, students make a recommendation for the best placement of the new park.

All of these tasks have been released to the public and can be used by parents, students, and teachers by visiting **http://nationsreportcard.gov/science_2009/ict_tasks.asp**.

Grade 12

Starlight

In this 20-minute task, students look at a way of classifying stars based on their temperatures and luminosities. Students then compare data on two stars, and predict how characteristics like their temperature and luminosity might change throughout their lives.

Energy Transfer

In this 20-minute task, students investigate which metal would be better for making the bottom of a cooking pan. While designing and conducting their investigations, students use a simulated calorimeter to test the specific heat capacities of two metals that could be used for the bottom of the pan.

The Phytoplankton Factor

In this 40-minute extended task, students investigate the role of phytoplankton (microscopic, plant-like organisms that live near the ocean surface) in the Earth's carbon cycle. In addition, students analyze an authentic set of experimental data relating levels of iron and nutrients to the growth of phytoplankton, and use a resource library to research ocean locations where increased iron levels might affect phytoplankton growth.

Table 2.

Average percent correct score for all interactive computer tasks in NAEP science, by selected student characteristics and grade: 2009

		Gender		Race/ethnicity				Eligibility for NSLP[1]	
	All students	Male	Female	White	Black	Hispanic	Asian/ Pacific Islander	Eligible	Not eligible
Grade 4	42	42	42	47	32	36	49	36	48
Grade 8	41	40	41	45	34	33	50	34	46
Grade 12	27	27	28	30	19	24	33	—	—

— Not available.

[1] National School Lunch Program.

NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

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What Did We Learn?

Key Discovery 1

Students were **successful** on parts of investigations that involved limited sets of data and making **straightforward observations** of that data.

FOR EXAMPLE

Mystery Plants

GRADE 4

80% of students could use a simulated greenhouse to test how three levels of sunlight affected plant growth. Students could use six different trays of the same plant type to test the three conditions, which allowed for a more straightforward observation.

Playground Soil

GRADE 8

84% of students could use a simulated laboratory to test how much water flowed through two different soil samples. Students who did this correctly made the straightforward observation that one soil sample allowed more water flow than the other.

Maintaining Water Systems

GRADE 12

75% of students could use test strips to test water samples for the levels of four pollutants, record the data, and interpret whether the results exceeded EPA standards. This part of the investigation was straightforward because students did not have to manipulate variables.

Key Discovery 2

Students were **challenged** by parts of investigations that contained **more variables** to manipulate or involved strategic decision making to collect appropriate data.

FOR EXAMPLE

Mystery Plants

GRADE 4

35% of students could select from nine possible fertilizer levels to test and determine those best for growth of a sun-loving plant. However, students had only six trays available during any single test run; therefore, students had to make strategic choices to assure that an adequate range of data was sampled.

Magnetic Fields

GRADE 8

24% of students could appropriately decide how to manipulate four metal bars made of unknown materials to determine which ones were the magnets. Because students could use only the four bars for this investigation, they had to apply their knowledge of how to test for magnetic properties.

Energy Transfer

GRADE 12

25% of students designed and conducted an investigation using a simulated calorimeter, and related patterns in temperature changes in two different metals to decide which metal has the higher specific heat capacity. Students had to interpret this complex set of data and relate it to their knowledge that the metal with the higher specific heat capacity caused the temperature of the water to change more than the metal with the lower specific heat capacity.

Key Discovery 3

The percentage of students who could **select correct conclusions** from an investigation was **higher** than for those students who could select correct conclusions and **also explain** their results.

FOR EXAMPLE

Cracking Concrete

GRADE 4

71% of students could select the correct conclusion about how volume changes when ice melted into water, while **15%** could select the correct conclusion and support this conclusion with evidence from the investigation.

Bottling Honey

GRADE 8

88% of students could select the liquid that flowed at the same rate as water at a given temperature, while **54%** could select the correct liquid and support this conclusion in writing using evidence from their investigation.

Energy Transfer

GRADE 12

55% of students were able to select the correct temperature changes that occurred when a warm solid object was placed into cool water, while **27%** were able to make the correct selections and explain how heat was transferred from a warmer to a cooler substance.

Table 3 provides a summary of the results used to support the three key discoveries from the hands-on and interactive computer tasks. The mean percent correct represents the proportion of students who answered multiple-choice questions correctly and accounts for at least partial credit on constructed-response questions. Science content experts examined all of the scored tasks to find the patterns in the results. The table shows the minimum, maximum, and median percent correct to demonstrate the ranges of student performances on the skills identified within each of the key discoveries.

Table 3.

Percent correct supporting key discoveries for hands-on and interactive computer tasks in NAEP science at grades 4, 8, and 12: 2009

	Number of items across grades and assessment type	Percent correct		
		Minimum	Maximum	Median
Key Discovery 1: Straightforward observations	12	42	94	76
Key Discovery 2: Strategic decision making	11	22	63	36
Key Discovery 3: Correct conclusion	9	35	93	71
Key Discovery 3: Explain results	9	9	44	30

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Both the hands-on and interactive computer tasks can be **successfully** administered in a large-scale assessment setting, using standardized, controlled procedures so as to ensure the collection of valid assessment data.

EXPLORE THE TASKS

This report is the print companion to the NAEP interactive website at **http://nationsreportcard.gov/science_2009/**.

What Else Did We Learn?

Results for the interactive computer and hands-on tasks can also be reported by race/ethnicity, gender, and eligibility for the National School Lunch Program. Many of the results for groups are consistent with the findings from the main paper-and-pencil NAEP science test; however, there were some differences. The full results by student group are available in tables 1 and 2, and the main paper-and-pencil science results are available online at **http://nationsreportcard.gov/science_2009**.

- Female students in all three grades **scored higher** than males on the hands-on tasks, though males **scored higher** on the traditional paper-and-pencil science assessment. There was **no gender gap** in interactive computer tasks.
- At grades 4 and 12, Hispanic students **scored higher** than their Black peers on both the hands-on tasks and interactive computer tasks.
- White and Asian/Pacific Islander students in all three grades **scored higher** than their Black and Hispanic peers on both the hands-on tasks and interactive computer tasks.
- There was **no score gap** between White and Asian/Pacific Islander students in any of the three grades on the interactive computer and hands-on tasks; however, on the main science assessment, White students **scored higher** at grades 4 and 8.
- There was an **achievement gap** at grades 4 and 8 between students from higher- and lower-income families in both the hands-on tasks and the interactive computer tasks.

What Are Students Doing in Science Classrooms?

As part of the main paper-and-pencil 2009 science assessment, students and teachers answered survey questions about science learning and instruction. These examples provide some context for student performance on the interactive computer and hands-on tasks in science. The full results for these contextual variables are in tables A–D on page 19.

- **39%** of fourth-graders and **57%** of eighth-graders had teachers who reported at least a moderate emphasis on developing scientific writing skills.
- **28%** of twelfth-graders reported writing a report on a science project at least once a week.
- **51%** of twelfth-graders reported designing a science experiment at least once every few weeks.
- **53%** of all twelfth-graders reported that they were currently taking a science course.
- **92%** of fourth-graders and **98%** of eighth-graders had teachers who reported doing hands-on activities with students at least monthly.

Inside the Tasks

Hands-On Task — Maintaining Water Systems

For this task, grade 12 students were asked to investigate the best site for building a new town based on the quality of a given water supply. Using the provided laboratory equipment and materials, students had to test water samples for levels of specific pollutants and evaluate water treatment processes.

Below are the results for each step of the experiment students performed.

Step 1: Predict

Students made a preliminary recommendation for the site of a new town based on the information provided about the quality of water sources.

64% of students explained their preliminary recommendations with valid support based on the materials in their kits.

Step 2: Observe

Students performed water tests and evaluated data in comparison to national drinking water standards.

75% of students could perform a straightforward investigation to test the water samples and accurately tabulate data.

Step 3: Explain

Students made a final recommendation for the site of a new town based on all of their data. Regardless of their performance on the first two steps, twelfth-graders struggled to explain their results.

11% of students were able to provide a valid final recommendation by supporting their conclusions with details from the data.

Steps 4 and 5: Extend

Students extended their inquiries by matching pollutants to specific water treatment steps and describing these processes in detail.

14% of students were able to correctly evaluate water treatment steps and select those that would be needed to remove pollutants that exceed national drinking water standards.

28% of students were able to describe scientific processes used to remove water pollutants.

Table 4.

Percentage of twelfth-grade students who successfully completed each step of the Maintaining Water Systems hands-on task in NAEP science, by selected student characteristics: 2009

		Gender		Race/ethnicity			
		Male	Female	White	Black	Hispanic	Asian/ Pacific Islander
Predict	Step 1	63	64	68	39	58	76
Observe	Step 2	74	76	84	50	59	66
Explain	Step 3	9	13	13	3	6	17
Extend	Step 4	17	11	17	1	6	13
Extend	Step 5	30	27	31	13	19	39

NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Watch a short online video to learn more about hands-on tasks and to view a demonstration of twelfth-grade students completing the Maintaining Water Systems experiment.

EXPLORE THE TASKS

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Interactive Computer Task—Mystery Plants

Grade 4 students designed and conducted three different experiments in this task, with the difficulty increasing as they proceeded. They were given a series of simulations and asked to determine the following:

Experiment 1: What are the best sunlight conditions for growth for Plant A (a sun-loving plant)?

Experiment 2: What are the best sunlight conditions for growth for Plant B (a shade-tolerant plant)?

Experiment 3: What are the best fertilizer amounts for growth for Plant A?

All of the experiments above required students to make predictions and observations and to explain their conclusions. Below are the results for each step of the three experiments that students performed.

Step 1: Predict

Students were asked about the sunlight and fertilizer that plants need. They were assessed on their ability to understand that different plants need different amounts of each.

59% of students displayed complex prior knowledge in experiments 1 and 2, understanding that different plants have different sunlight needs.

56% of students displayed complex prior knowledge in experiment 3, understanding that different plants have different fertilizer needs.

Step 2: Observe

Students were asked to observe and test across the range of available sunlight and fertilizer amounts, and investigate how these amounts correspond to the growth of the plants.

At least **80%** of students correctly performed this step in experiments 1 and 2, which involved limited sets of data and straightforward observations.

35% of students could correctly perform experiment 3, which contained more variables and required them to make strategic decisions about the best fertilizer levels for growth of a sun-loving plant.

Step 3: Explain

Students were required to select the correct conclusion for each investigation and provide an explanation for each.

While a higher percentage of students could select the correct conclusion for each of the three experiments, **36%** of students could explain their conclusions with supporting evidence from their investigation in experiment 1, **29%** in experiment 2, and **46%** in experiment 3.

Table 5.

Percentage of fourth-grade students who successfully completed each step of the Mystery Plants (Experiment 1: Sunlight for Plant A) interactive computer task in NAEP science, by selected student characteristics: 2009

		Gender		Race/ethnicity				Eligibility for NSLP[1]	
		Male	Female	White	Black	Hispanic	Asian/ Pacific Islander	Eligible	Not eligible
Predict	**Step 1**	59	58	65	49	47	67	52	63
Observe	**Step 2**	80	79	81	79	74	86	78	81
Explain	**Step 3**	34	37	43	19	27	47	28	43

[1] National School Lunch Program.

NOTE: Black includes African American, Hispanic includes Latino, and Pacific Islander includes Native Hawaiian. Race categories exclude Hispanic origin.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Try it out! Go online to take Mystery Plants, or any of the other interactive computer tasks, and see how you would score.

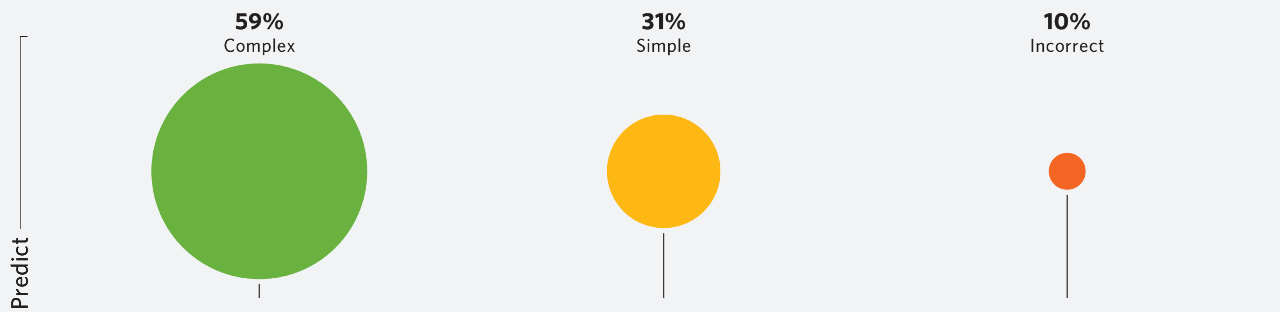
http://nationsreportcard.gov/science2009ict/mysteryplants/mysteryplants.aspx

EXPLORE THE TASKS

This report is the print companion to the NAEP interactive website at **http://nationsreportcard.gov/science_2009/**.

How Did Students Perform?

A step-by-step look at Experiment 1 of Mystery Plants

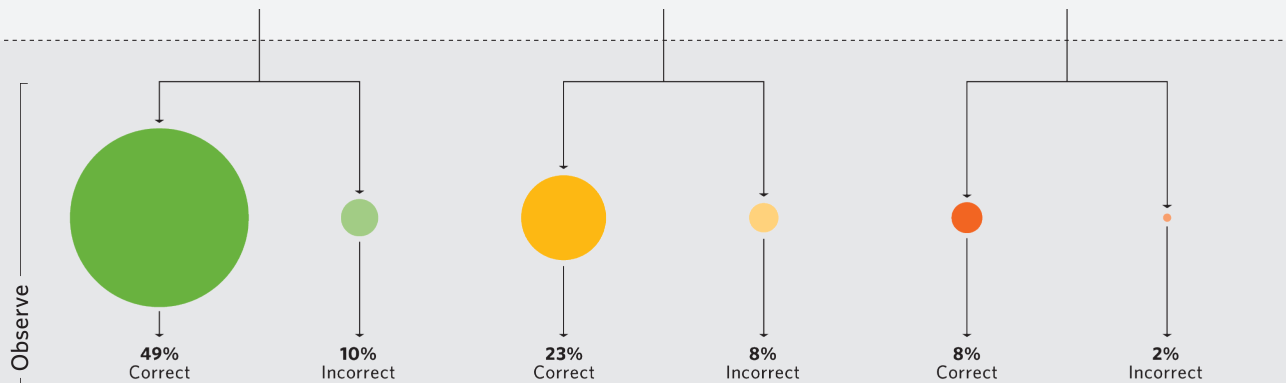


What prior knowledge did students bring to the problem?

Over one-half (**59%**) of all fourth-graders began the task with the understanding that different plants have different sunlight needs.

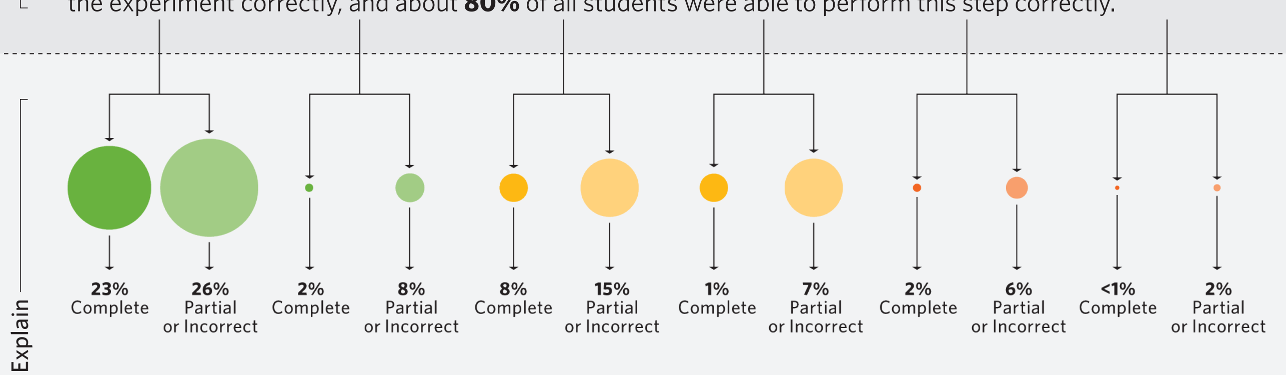
Approximately **31%** thought that all plants needed more sunlight to grow best.

About **10%** thought that sunlight didn't affect plants or thought that plants needed only a little bit of sunlight.



How well did students perform when using the simulated greenhouse?

Regardless of the prediction made based on their prior knowledge, fourth-graders were able to perform this straightforward observation. Almost half (**49%**) of students showed complex prior knowledge and performed the experiment correctly, and about **80%** of all students were able to perform this step correctly.



How well could students explain their conclusion?

23% of fourth-graders displayed complex prior knowledge, conducted the experiment correctly, and were able to explain the findings (as seen by following the leftmost series of green disks). However, the bottom row of disks shows that **36%** of students were able to provide a complete explanation, so some students who did not have complex prior knowledge or did not complete the experiment correctly were able to give complete explanations.

Visit the interactive website to explore more detailed results on how students performed at each step of the experiments.

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Technical Notes

Assessment Design

Science Interactive Computer Tasks (ICTs) and Hands-On Tasks (HOTs) were administered in 2009 at grades 4, 8, and 12. The two assessments were given to separate nationally representative samples; therefore, the results are not linked to each other or to the main operational science assessment. See **http://nationsreportcard.gov/science_2009/ict_indepth.asp** for more details on example tasks in the assessments.

Sampling and Accommodations

The target population for the ICT and HOT assessments consisted of fourth-, eighth-, and twelfth-graders enrolled in public and private schools nationwide. Each school that participated in the assessment, and each student assessed, represents a portion of the population of interest. Results are weighted to make appropriate inferences between the student samples and the respective populations from which they are drawn. While part of the sample, there were insufficient American Indian/Alaska Native students assessed to permit reporting. In addition, participation rates fell below the 70 percent guideline for private schools, and therefore results cannot be reported separately.

The results for the ICT and HOT assessments are based on administration procedures that allowed accommodations for students with disabilities (SD) and English language learners (ELL) selected to participate in the two assessments. Appropriate accommodations were determined by school officials. Read-aloud accommodations were provided for HOTs and short ICTs, but were not provided for the extended ICTs. As a result, a small portion of students in the ICT assessment who required read-aloud accommodations were only given the two short ICTs at that grade level. See tables showing the accommodations and participation rates at **http://nationsreportcard.gov/science_2009/ict_tech_notes.asp**.

National School Lunch Program

NAEP collects data on student eligibility for the National School Lunch Program (NSLP) as an indicator of low income. Under the guidelines of NSLP, children from families with incomes below 130 percent of the poverty level are eligible for free meals. Those from families with incomes between 130 and 185 percent of the poverty level are eligible for reduced-price meals. (For the period July 1, 2008, through June 30, 2009, for a family of four, 130 percent of the poverty level was $27,560, and 185 percent was $39,220.) Some schools provide free meals to all students irrespective of individual eligibility, using their own funds to cover the costs of noneligible students. Under special provisions of the National School Lunch Act intended to reduce the administrative burden of determining student eligibility every year, schools can be reimbursed based on eligibility data for a single base year. Participating schools might have high percentages of eligible students and report all students as eligible for free lunch. Because students' eligibility for free or reduced-price school lunch may be underreported at grade 12, the results are not included in this report but are available on the website at **http://nationsreportcard.gov/science_2009/**.

Reporting Results

As with all other NAEP assessments, student responses to constructed-response items were scored according to standard scoring procedures. The data from scoring were then analyzed to create summaries of student performance, as shown in this report. As shown in the summary of major results and the examples for ICTs and HOTs, an *item percentage correct* statistic was used to summarize student performance. This statistic represents the percentage of examinees who received a correct score on the question for a multiple-choice or dichotomous constructed-response question. For a multilevel constructed-response question, the item percentage correct statistic is calculated by summing a weighted percentage of students attaining each score level. The weight is based on the number of levels in the scoring criteria for the question.

Student performance across the three ICTs or two HOTs per grade level was also summarized as a student percent correct score. This percentage was calculated as the total score for a student across multiple tasks in the assessment and then divided by the maximum possible score for the questions the student attempted and multiplied by 100. For example, suppose a student attempted five questions in the first ICT task, four in the second task, and four in the third task, yielding a total score of 30. (Note that constructed-response items are "weighted" based on the number of score categories, e.g., a 4-category item has a weight of 3 with students getting 0, 1, 2, or 3 points credit on the item.) In addition, suppose that the maximum possible score for the 13 items the student attempted is 45. Then the student's percent correct score would be 30 divided by 45 multiplied by 100, which equals 67. The sum of scores for those items that students attempted, not all the items that appeared in an assessment, is used as

the denominator of the student percent correct score. This method is used because NAEP assessments are intended to be non-speeded, implying that students should not be penalized for failing to reach particular questions because of time limitations. More information on the percent correct scores is available at **http://nationsreportcard.gov/science_2009/ict_tech_notes.asp**.

Interpreting the Results

NAEP reports results using widely accepted statistical standards; findings are reported on a statistical significance level set at .05 with appropriate adjustments for multiple comparisons. Only those differences that are found to be statistically significant are discussed as higher or lower.

Table A.

Percentage of students in NAEP science, by teachers' responses to a question about emphasizing the development of scientific writing skills when teaching science and grade: 2009

To what extent do you emphasize developing scientific writing skills in teaching science to your class?	Not at all	Small extent	Moderate extent	Large extent
Grade 4	14	47	31	8
Grade 8	4	38	41	16

NOTE: Detail may not sum to totals because of rounding.

Table B.

Percentage of students in NAEP science, by teachers' responses to a question about students doing hands-on activities or investigations in science class and grade: 2009

About how often do your science students do hands-on activities or investigations in science?	Never or hardly ever	Once or twice a month	Once or twice a week	Every day or almost every day
Grade 4	8	42	40	11
Grade 8	2	25	56	17

NOTE: Detail may not sum to totals because of rounding.

Table C.

Percentage of students in twelfth-grade NAEP science, by their responses to a question about doing various activities during the year in science class: 2009

In your science class this year, how often do you do the following activities?	Never or hardly ever	Once every few weeks	About once a week	Two to three times a week	Every day or almost every day
Write a report on your science project or activity	39	33	20	6	2
Design a science experiment	49	28	16	5	2

NOTE: Detail may not sum to totals because of rounding.

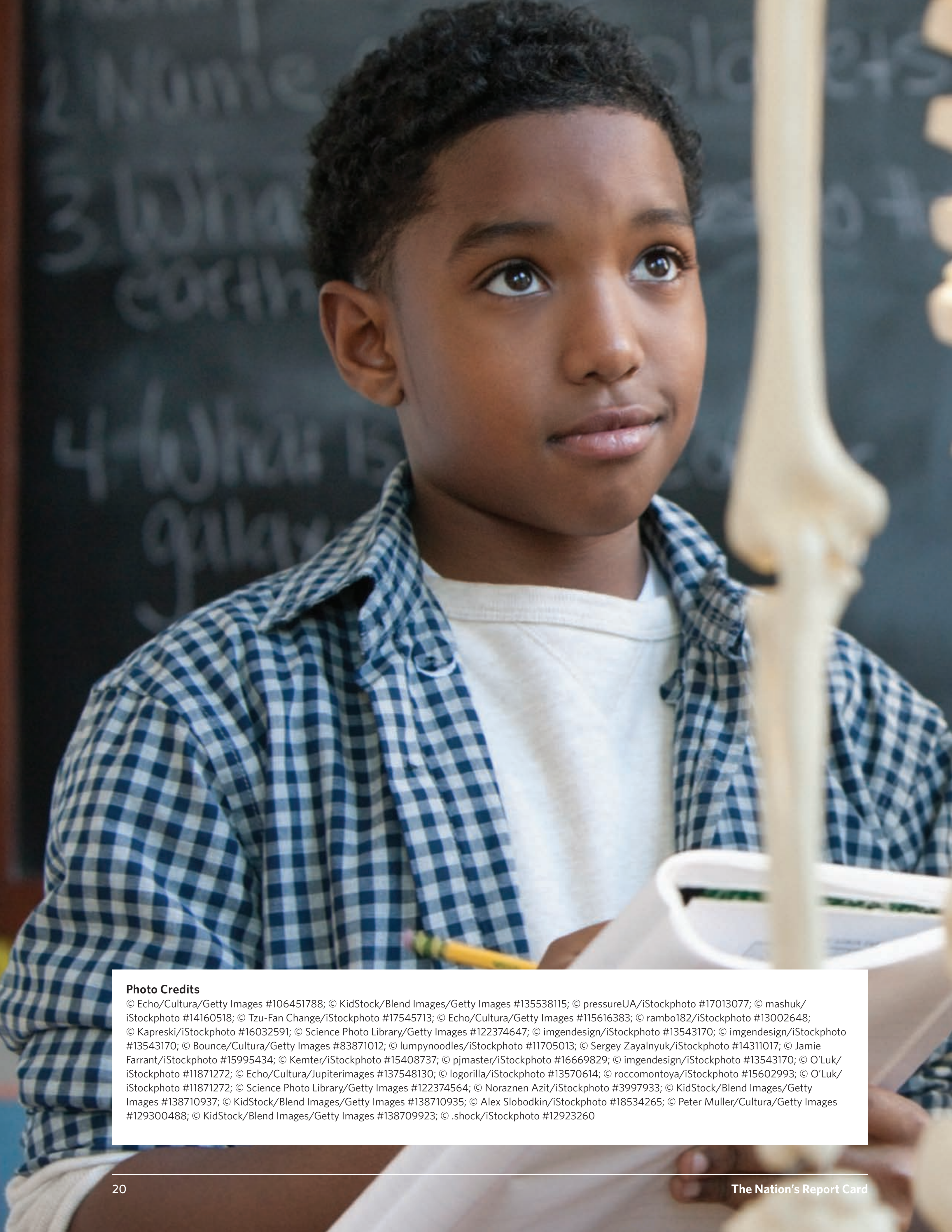
Table D.

Percentage of students in twelfth-grade NAEP science, by their responses to a question about taking a science course: 2009

Are you currently taking a science course?	Percentage of students
Yes	53
No	47

NOTE: Detail may not sum to totals because of rounding.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.



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Science in Action: Hands-On and Interactive Computer Tasks From the 2009 Science Assessment

June 2012

Suggested Citation

National Center for Education Statistics (2012).

The Nation's Report Card: Science in Action: Hands-On and Interactive Computer Tasks From the 2009 Science Assessment (NCES 2012-468).

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